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Aviation Hazards in the Sky over Thada as Revealed by Meso-scale Meteorological Modeling

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ABSTRACT

The airplane of Nepal Army in-route to Kathmandu Airport from Nepalgunj lost its communication with the air traffic control room from the sky of Thada of Arghakhachi District. The plane was found with breath taking crashing over the Bowang high mountain area of Baglung District. The weather pattern over the area has been numerically reconstructed with the application of Weather Research and Forecasting (WRF) model initialized with NCEP FNL meteorological and USGS land use and terrain elevation data to examined the effect of prevailing weather pattern. The reconstructed weather pattern show that the atmosphere over Thada and associated areas capture an adverse condition for aviation activities, as it appears highly turbulent and is intense subsidence prone. A detail long-term investigation usefully complemented with field observation may provide better understanding and for improved flight safety.

Keywords: Weather reconstruction, weather hazards, aviation safety, turbulence, Thada.

INTRODUCTION

The Britten-Norman RAN 49 BN2T Islander aircraft of Nepal Army crashed at Chaudhulko Dhuri of Bowang-9, Baglung on 18 October 2011. The aircraft took off from the Nepalgunj Airport at 1825 local standard time (LST) and lost contact in-route to Kathmandu Airport at 1905 LST from the sky of Thada area of Arghakhanchi District. The aircraft was found crashed into the hillock located in the remote northern mountainous area close to Dhorpatan. The badly damaged bodies and the debris of the aircraft were found scattered up to 60 and 100 meters form the impact point (Fig. 1a). Local people witnessed the aircraft descending in the dark without any light eventually bursting into a fireball.

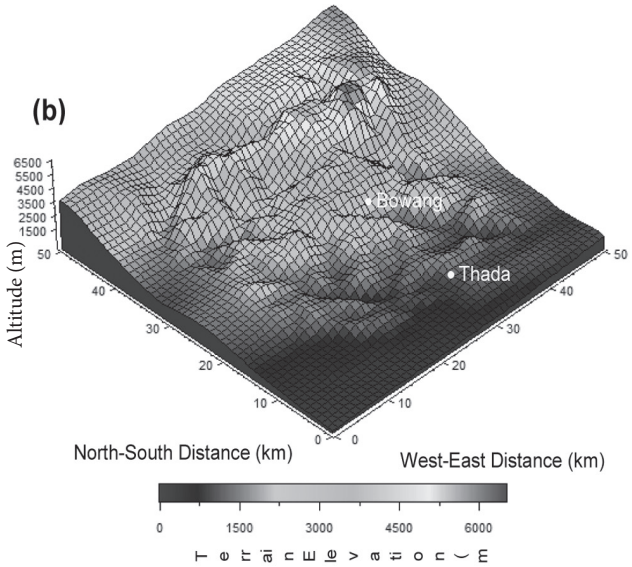


Fig. 1. Pictures of Britten-Norman RAN 49 BN2T Islander aircraft crashing into the hillock of Baglung District of Nepal (a) and Birdeye view of Thada and its surroundings (b).

It is of the interest of this study to reconstruct of the weather pattern in and around the Thada area for the day of RAN 49 BN2T aircraft crashing and to examine the implications of weather pattern on the flight as it was reportedly went out of contact from the sky of Thada with the application of Weather Research and Forecasting (WRF) modeling system. It is expected that present finding will provide an excellent starting point for further in-depth research of the subject over the area.

MATERIALS AND METHODS

The prevailing atmospheric conditions over the Thada area and its surrounding have been numerically simulated with the application of the Weather Research and Forecasting (WRF) Modeling System (Skamarock et al, 2005) using a triply nested two-way interacting domain system described elsewhere (e.g., Regmi, 2014).

The model was initialized with NCEP 6-hourly meteorological data with a resolution of 1.0° × 1.0°. The simulation was carried out for the period of 17 October 0000 UTC to 19 October 0000 UTC, 2011. The land use of 24 categories and 30-second terrain elevation data by United States Geological Survey (USGS) has been used in the calculation. The coarse and the fine domain include 51 × 51 × 34 grid points, and horizontal grid size is 9 and 3 km, respectively, whereas the finest domain include 70 x 70 x 34 grid points with horizontal grid size 1 km. The centers of all the three domains were placed at the center of the Hetauda Municipality. The planetary boundary layer (PBL), and surface layer schemes and the NOAH land surface model (LSM), along with the Dudhia short wave, RRTM long-wave radiation parameterizations for all the domains but the parameterization of schemes of Lin et al. as well as the Kain-Fritsch convective parameterization scheme was used only in the largest domain.

RESULTS

Since no meteorological observatories are in operation in and around the Thada area, it was not possible to validate the model prediction with observations. Nevertheless, as the model has reproduced a realistic weather patterns over the highly complex terrain of Himalayas (e.g., Regmi, 2014; Regmi, 2013) and same physical schemes are adapted for this study, present reconstruction of prevailing over the area can be expected to be not much deviated from the reality.

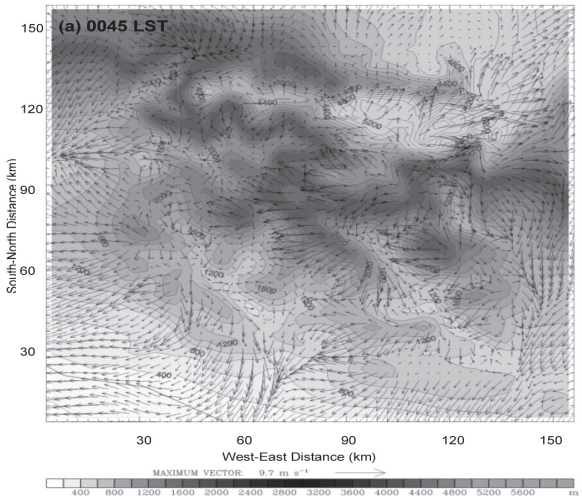
NEAR SURFACE WIND FEATURES

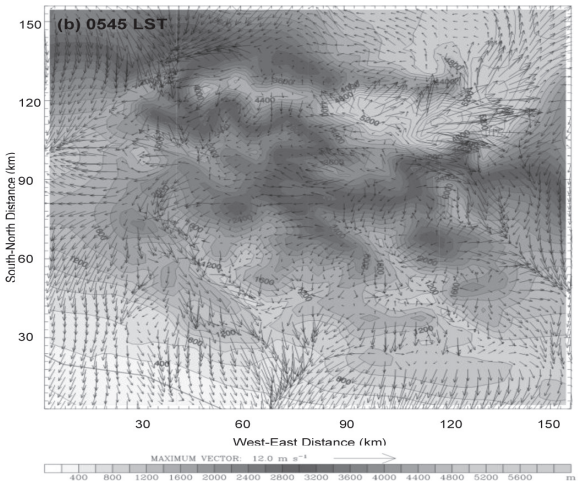
Fig.2 shows the spatial and diurnal features of the regional wind system over the area that includes Thada from where the RAN 49 BN2T Islander aircraft had made last communication and Bowang where it was found crashed (see black and white circles for Thada and Bowang, respectively, in Figs. 2c).

The distribution of near surface wind reveals that a very complex wind system prevails over the area during the night and morning times (see Fig 2a,b). The downslope wind that appears over the southern part of the calculation domain appears to be rather strong and northeasterly with speed of about 8 to 10 ms^{-1}. A persistent convergence of northeasterly and more northerly winds appears at the mouth of the valley located west to Thada. Over the Bowang area, it appears even more complex. Divergence of very strong wind over the surrounding ridges indicates that an intense subsidence should have occurred over the area.

In the late morning, the nighttime wind switches into the southwesterly over the southern part whereas it appears southeasterly along the valley of Bowang (see Figs. 2c, d). This flow pattern may continue until the afternoon time. However, in the late afternoon time, the wind appears to be northwesterly in the southern areas including Thada and west to it and westerly in the eastern area. Beyond this time, the wind system over the area appears to resume the nearly the same pattern described earlier for morning and nighttime.

It is important to note that during the calculation period the wind system over the area executed a diurnal periodicity. Examining diurnal patterns of the near surface wind system in and around the Thada and Bowang areas, it can be said that a highly adverse situation prevails over these areas to perform aviation activities most of the time including the early evening when the RAN 49 BN2T Islander aircraft's went missing from the Thada area. Since detail history of the crash was not available, an objective analysis was not possible.





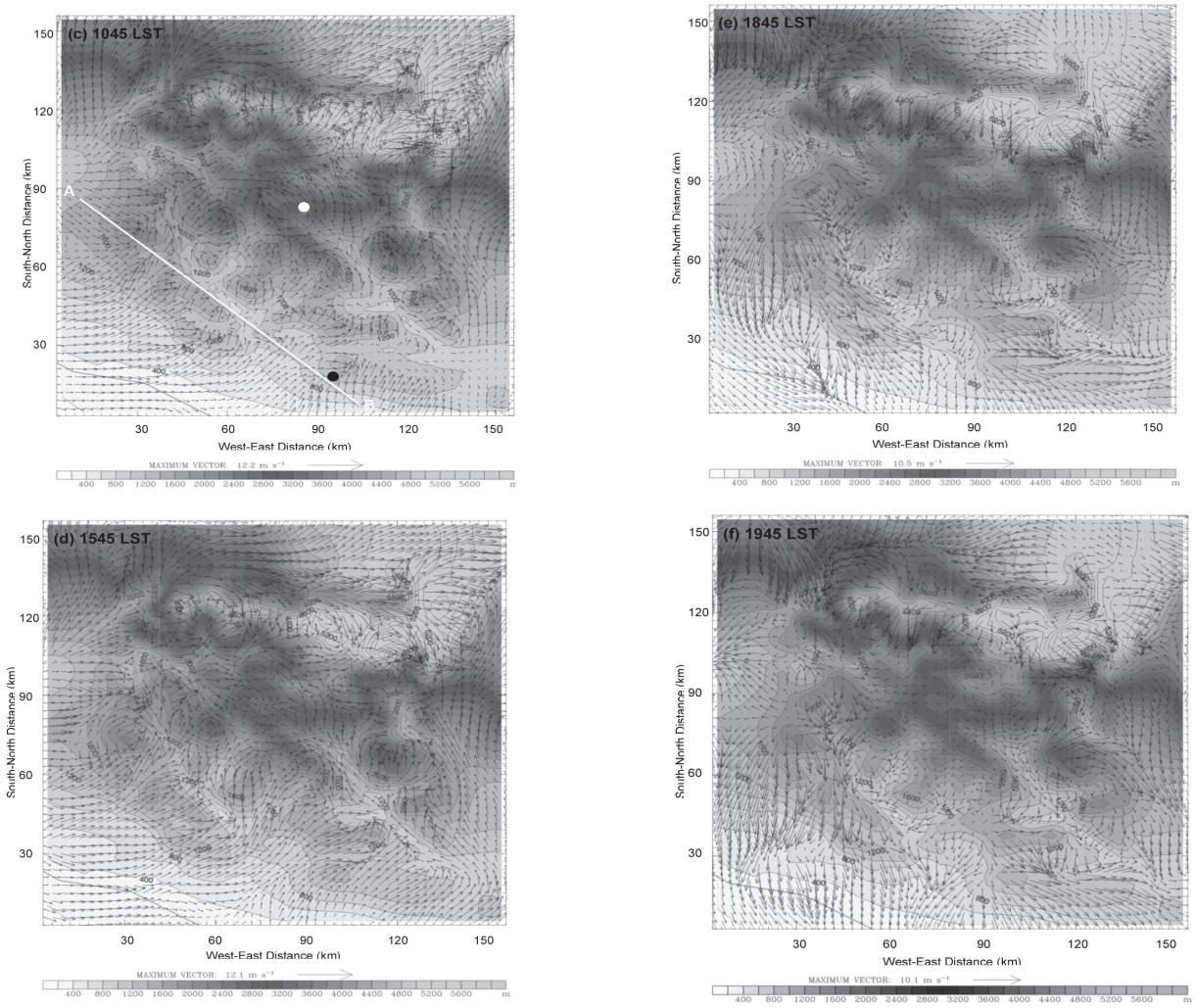


Fig. 2. Spatial and temporal distribution of wind over at 30 m height above the ground superimposed on the filled terrain contours. The black and white circles in Fig.2c indicate the Thada and Bowang area, respectively, and along the line A—B, cross-sectional distributions of wind, potential temperature and Richardson Number are discussed.

VERTICAL STRUCTURE OF WEATHER PATTERN

Fig. 3 shows the composite cross sectional distribution of wind, potential temperature, and the Richardson number. Examining series of hourly-predicted patterns, it can be said that during the period of night and early morning, strong southeasterly wind appears to flow at higher level (Figs. 3a&b). The downdraft from the lower level of this flow might have intensified the surface flow apparent in the Figs. 2a&b. The overturning of potential temperature contours and the lower values of Richardson number of over the Thada area together with the downdraft makes the sky over Thada area highly turbulent and vulnerable for aviation activities over the area during the night and early morning times.

During the period of late morning and the afternoon, the situation appears to be very dangerous as the immediate atmosphere as well as some pocket areas aloft along the whole cross-section is very turbulent accompanied with series of updraft and downdrafts as well as formation of rotors are apparent (Figs. 3c,d). In the late afternoon and early evening (Figs. 3e, f), the prominent southeasterly in the upper layer of the atmosphere along the cross-section appears to be weak but the merged of northwesterly and the southwesterly downdrafts appear to enhance the downslope wind (Figs. 2e, f) over the whole southern part of the calculation domain. The converging and diverging winds over the Thada and its west east and northeast areas (Figs. 2e,f) during the late afternoon and early evening can be considered to be significantly hazardous although the situation appears very mild compared to afternoon. The presence of low Richardson number and overturning of potential temperature contours just over the Thada (Fig.3e) close to the time of communication breaking with RAN 49 BN2T aircraft indicate that the atmospheric conditions were not suitable to fly.

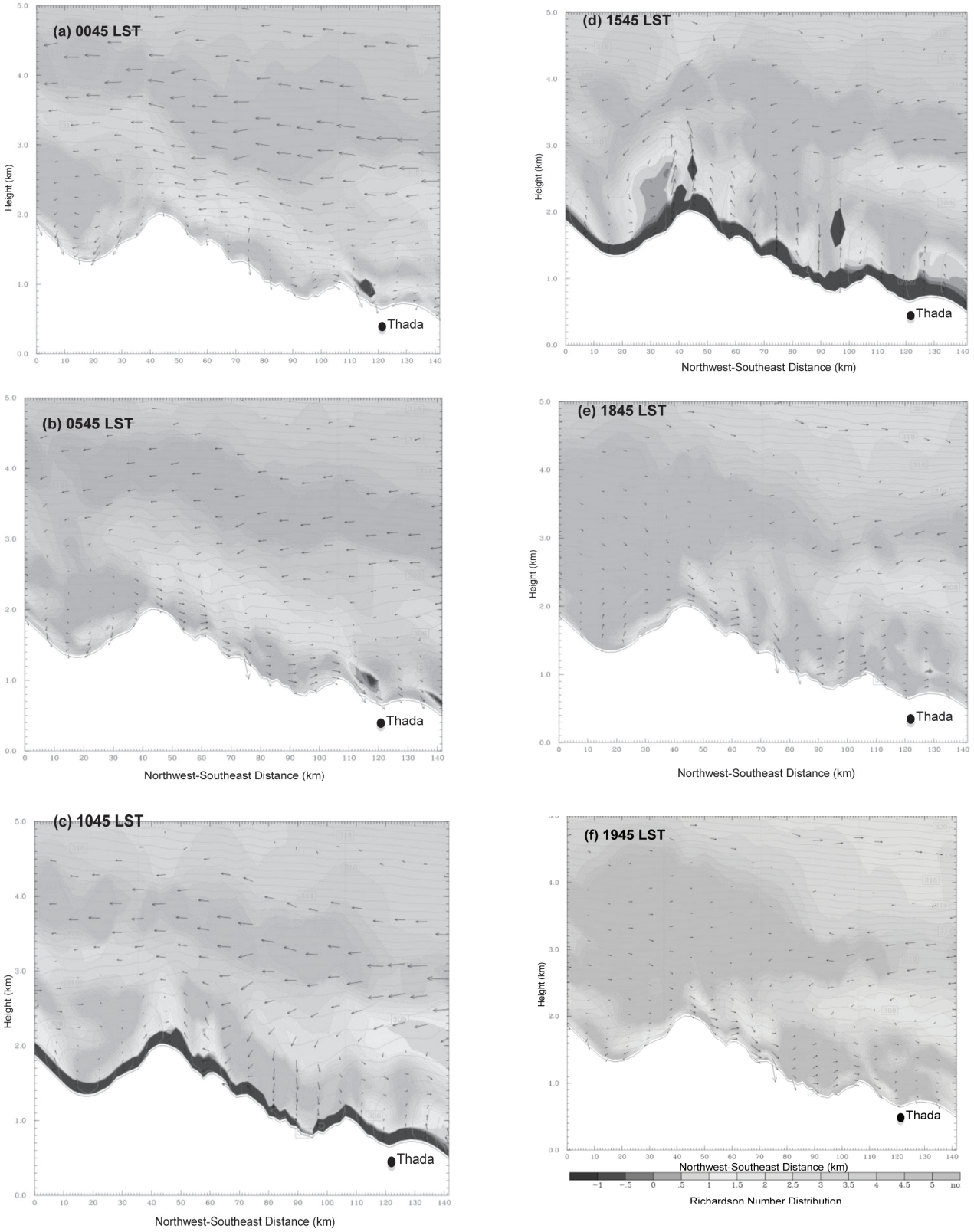


Fig. 4. Cross-sectional distribution of wind (black arrow), potential temperature (green contours), Richardson Number (color) along the line A—B on 18 February 2011.

Fig. 5 shows the cross-sectional distribution of temperature and humidity along the same line A—B in which the wind, potential temperature and Richardson Number distribution were discussed in Fig. 4 close to the time of aircraft missing. Fig. 5a,b and Fig.5c,d , respectively, show the temperature and relative humidity distributions. From these distribution patterns, that is, low humidity and higher temperature in and around the Thada area, the possibilities of icing, visibility obstructions as well as lightning effects can be ruled out. However, it should be noted that hourly predictions of atmospheric situation might not represent the exact situation over the area at the time aircraft missing.

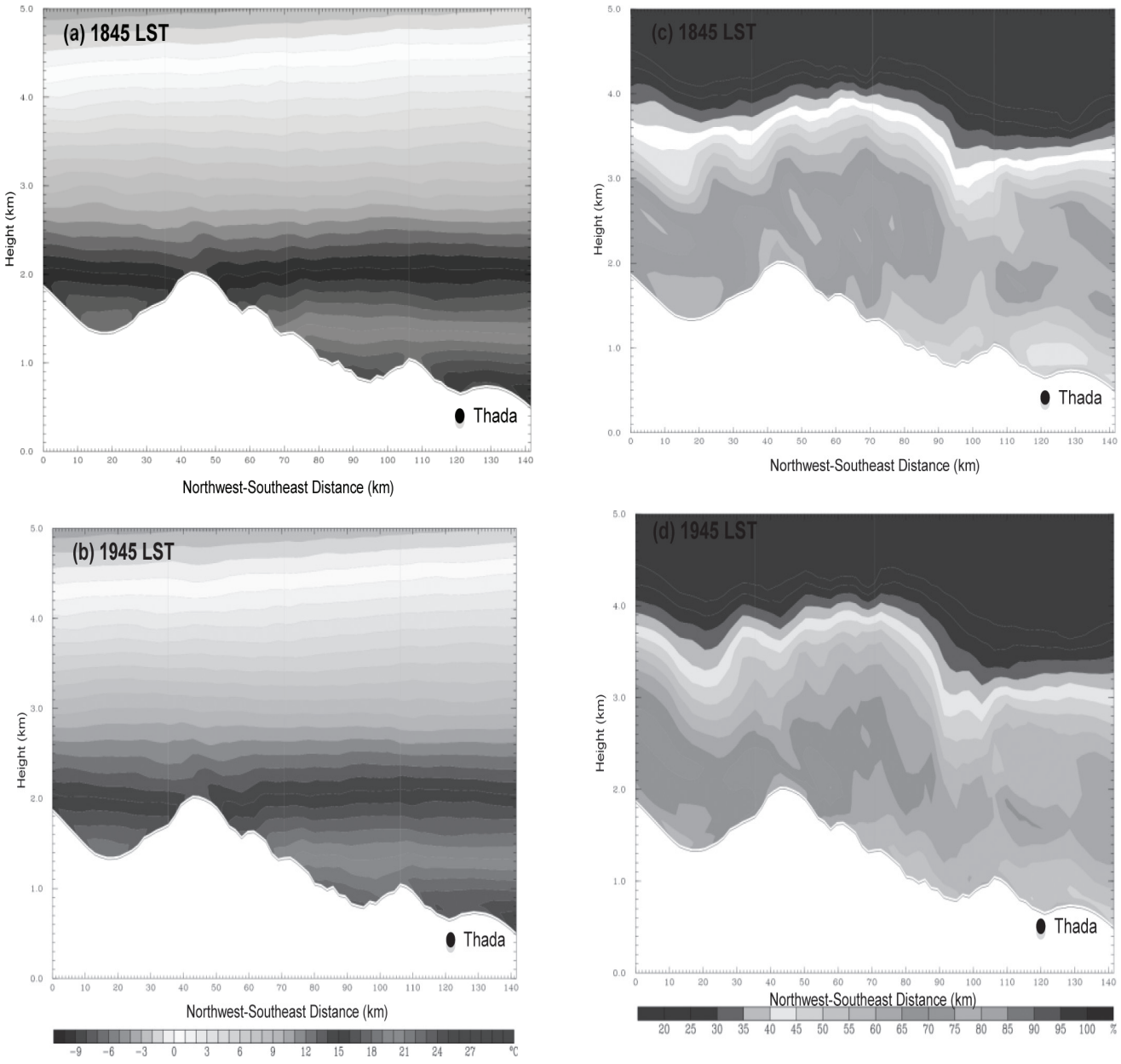


Fig. 5. Cross-sectional distribution of temperature (a, b) and relative humidity (c, d) along the line A—B on 18 February 2011.

The lack of necessary information on the flight history, weather observation and technical details of aircraft and its performance prevented to make a detail assessment on the impact of prevailing weather condition over the area.

CONCLUSIONS

The weather condition in and around the Thada area has been numerically simulated with the application of Weather Research and Forecasting (WRF) Model. The sky over Thada and along the air-route through the southern foothills of Himalayas in the western and Midwestern Region of Nepal is highly turbulent and witnesses intense downdrafts most of the time during the day. As other weather factors such as icing or visibility obstruction can be ruled out, the turbulence over the area might have contributed for the fatal accident of RAN 49 BN2T aircraft. Present investigation need to be continued extensively complemented with extensive field observations better understanding and assessment of weather hazards in and around the Thada area.

ACKNOWLEDGEMENTS

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